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Effect of Luna sensation Fungicide Against Powdery Mildew (*Leveillula taurica*) of Pepper(*Capsicum spp.)* in Central Rift Valley of Ethiopia

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Abstract
Pepper has been grown as important spice and vegetable in the country and has gained economical and traditional importance. Currently, outbreak of powdery mildew caused by the fungus (Leveillula taurica) is occurring in major pepper producing areas of Ethiopia, causing a significant decline in quantity and quality of pepper yield. Field experiments were conducted in Ethiopia to evaluate the effect of Luna sensation against pepper powdery mildew**(**Leveillula taurica**).** Luna sensation significantly reduced the population powdery mildew, mean wilt incidence, percent severity index, and corresponding areas of disease incidence, in marakofana pepper cultivar. Similarly, Bayleton resulted in a significant reduction of mean disease incidence and percent severity index, and Leveillula taurica population compared to unsprayed check in marakofana pepper cultivar. both Luna sensation and Bayleton increased fruit quality and yield when compared with untreated check. mean yield, dry weight, fresh weight, marketable and unmarketable fruit weight, total pod number and yield loss per plot are significantly different among Luna sensation, bayleton and unsprayed check.
Keywords: powdery mildew; Leveillula taurica; Luna sensation; Bayleton; Pepper (marakofana); and unsprayed check

1. INTRODUCTION

Cultivated peppers are members of the genus *Capsicum spp*. Since its introduction in the early 17th century by the Portuguese (Huffnaga, 1961), to Ethiopia pepper has been grown as important spice and vegetable in the country and has gained economical and traditional importance. Their production and consumption have steadily increased worldwide due to their roles as vegetable and spice. At present, the yield of pepper in Ethiopia is very low (0.4 tones fruit yield/ha) (Fekadu *et al.,* 2008).

Several diseases affect the production and marketability of pepper in Ethiopia (Agronvsky, 1993; Yaynu, 2001; Tameru, 2004). Poty viruses such as Ethiopian Pepper Mottle Virus and Potato Virus appeared to be very important in the rift valley parts of Ethiopia (Yaynu *et al*., 2001; Tameru *et al*., 2003).

Currently, outbreak of powdery mildew caused by the fungus (*Leveillula taurica)* is occurring in major pepper producing areas of Ethiopia, causing a significant decline in quantity and quality of pepper yield. Powdery mildew can occur on peppers in a dry or humid climate because the conidia of *L. taurica* can germinate and develop a germ tube under any level of relative humidity (RH) from 0-100% if temperatures are between 18-33°C (64-91°F) (Goldberg 2003, Basler and Lang 2012).

A number of disease management practices have been recommended for the control of pepper powdery mildew. These include host resistance, cultural control and chemical control. Application of chemicals is a very common disease management practice in vegetables production in Ethiopia. However, resistant development by the target pathogen, toxic effect to the host is major problems for vegetable production. It is important to test various fungicides to generate their local efficacy data and facilitate registration. Testing fungicides from different chemical groups is also important to reduce or avoid development of resistance. The aim of this research is to evaluate and avail options of fungicides for the management of pepper powdery mildew.

2. MATERIALS AND METHODS

2.1 Study Location and Site Characteristics

The experiments were carried out in Ethiopia at Melkassa Agriculture Research Center (MARC) located at 8°24'985 N latitude and 39°19'529 E longitudes, with an altitude of 1,550meter above sea level. The average annual rainfall in the area is 763mm, about 70% of which is received during the main rainy season from June to September. The annual average maximum temperature is 28.4^0 C, the minimum average temperature 14^0C. The investigations were conducted at important pepper growing location in the central rift valley of Ethiopia. this location was characterized by dry sub humid climate.

2.2 Treatments and experimental design

The current investigation was carried between November, 2015 to July, 2016 using marakofana pepper variety. Seed sources were from Ethiopian Institute of Agricultural Research, Melkassa Agricultural Research center (MARC). Seedlings were raised in seed beds and transplanted to an open field at the 4-5 leaves stage. The

experiment was conducted in standard pesticide verification plot size(10mx10m) with treatments Luna sensation, bayleton and unsprayed check(control). The plot size was 10m X 10m with 14 rows to accommodate 467 plants per plot. Intera-row spacing of 0.3m and inter-row spacing of 0.70m were used for the experiments. Crop management practices were carried out as per needed or recommended except fungicide use. Experimental field were seriously scouted to now the right time of the pathogen occurrence and to decide the right time for fungicide spray. In this experiment fungicide spray were started after the pathogen were observed on the lower part of the plant, with disease severity up to 5 percent and with the rate of 5gm/100m^2 and 3ml/100m^2 bayleton and Luna sensation respectively. Active ingredient were mixed with water amount of 200 liter per hectare and Volume of water will vary depending on crop growth stage.

2.3 Data Collection And Analysis

2.3.1 Disease intensity

Starting seven days after transplanting, plants in each plot were monitored for diseases symptoms and infection. Powdery mildew incidence on each experimental plot was recorded by counting number of diseased plants and calculating as the proportion of the diseased plant over the total number of stand count on the plot. Each plant within each plot was visually evaluated for percent of foliar infection (severity). Further, disease severity data were converted to a rating scale according to affected leaf area. where: 0, no symptoms; 1, with 10% of the leaf area affected; 2, with 11-25% of the leaf area affected; 3, with 26- 50% of the leaf area affected and 4 with 51-75% of the leaf area affected, 5 with 76% or more of the leaf area affected.

2.3.2 Yield components

The fruits were harvested when they reached full maturity. Harvesting started at the end of june,2016 and Measurements were done on 5 plants in each treatments which had been randomly chosen from the middle row of a plot, and the mean values were used to represent each experimental unit. The traits recorded include: number of fruits per plant (count),number of branch per plant(count), number of infected leaf from upper and lower branch(count), dry fruit yield per plant (gm), marketable weight(gm) and unmarketable fruit yield per plant (gm).

2.3.3 Data Analysis

Mean value of disease incidence, severity and yield components were subjected to repeated measures of analysis of variance (ANOVA) to evaluate treatments effect. The analysis was done using the general linear model of statistical analysis using SAS computer package version 9.11 (SAS Institute Inc, 2003 version). Means for different treatments were compared using least significant difference test at 5% significance level (LSD5%).

3. RESULTS AND DISCUSSION

3.1 Importance of powdery mildew(*Leveillula taurica)*

Production of pepper in many corner of Ethiopia is tackled by disease with one of major important disease called powdery mildew. This disease attacks the leaf part of the plant which affects the production of glucose and water which is used by other part of the plant for the continuity of life cycle of the plant. It is important to be aware of powdery mildew and its management as the resulting disease can significantly reduce crop yields.([L] Maloy, Otis and Debra Inglis (1993))

Recently (2015) due to this disease production of pepper were replaced with cereal crops in merako, sodo and meskan districts which is previously a belt for pepper production in Ethiopia(personal Information). In this experiment the symptom of powdery mildew were seen in the beginning of April, 2016. Pepper was majorly affected with powdery mildew and the incidence was recorded to 100 percent.

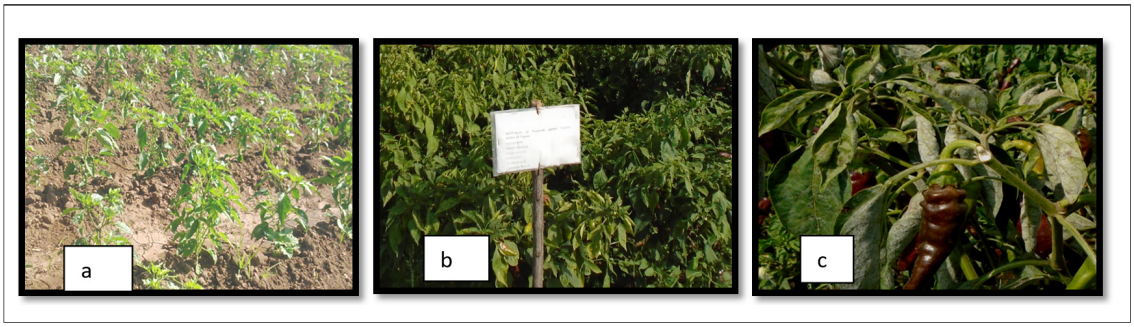

Figure 1:- showing(a), no disease seen at vegetative stage, (b), showing treated plot with fungicide, (c), shows untreated check, exposed fruit to sun light)

For occurrence of powdery mildew wide humidity (0-100%) range is possible because conidia of *L. taurica* contain sufficient water to germinate and initiate growth (Smith et al. 1999). Leaves showing lesions may eventually turn entirely chlorotic or brown (Goldberg 2003). Symptoms develop first on older leaves, and as the

infection increases, these leaves will drop prematurely (Elad et al. 2007, Basler and Lang 2012).
As these leaves drop, the developing fruit is exposed to direct sunlight, and they become sunburned and unmarketable. In severe infections when defoliation is high, yield losses to sunburned fruit can range from 50-60% (Smith et al. 1999). The percentage of sun burn fruit were recorded 3%, 16% and 29% for Luna sensation , bayleton and unsprayed check respectively.

Table 1. Mean marketable and unmarketable yield of pepper per five plants among three treatments. Melkassa, June 2016

Treatment	*Marketable pod number*	*Marketable pod weight*	*Unmarketable pod number*	*Unmarketable pod weight*	*Yield loss per 100m2*
Luna	***29.4***	***57.2***	*7*	***10***	***14***
BYLT	***23.2***	***45.2***	***12.4***	***28.6***	***39***
CONT	***12.8***	***18.6***	***11.8***	***20.6***	***55***
LSD(p≤0.05)	***0.046****	***ns***	***0.026****	***ns***	***ns***

Luna(Luna sensation), BYLT(bayleton) and CONT(control)

Mean marketable and unmarketable yield of fruit number per five plant were counted and statistically there is significant difference among treatments. The weight of fruit among treatments were not statistically significant, But when the mean value of each treatment are compared there is difference. yield loss were converted to plot wise and loss were high in untreated check.

Table 2. Mean effect of yield component among treatments on powdery mildew of pepper: Melkassa, June 2016

Treatments	***Total pod number***	***Sunburn pod number***	***Fresh weight***	***Dry weight***	***Yield per 100m2(Kg)***
Luna	*37.8*	*1.4*	*208.28*	*66.4*	*6.2*
BYLT	*42.8*	*7.2*	*247.54*	*74.4*	*6.9*
CONT	*34.6*	*10*	*100*	*41.6*	*3.89*
LSD(p≤0.05)	*0.038**	*ns*	*0.05**	*0.025**	*0.024**

Mean total pod number per five plant among treatment are significantly different as shown in table 2. the number of sunburned fruit number were high in untreated check but statistically not significant. In untreated plot the upper side of the leaf show yellowing symptom and the lower part have a sign of powdery mildew. Up on Maturing, the leaf of untreated plot were dropped and pod were exposed to sunlight and rather than red color the pod color were changed to white color. Fresh weight and dry weight were statistically significant similarly yield among treatments are different.

3.2 Effect of fungicides on development of *Leveillula taurica*

Population of ***Leveillula taurica*** was significantly reduced in Luna sensation and bayleton treated plots at application of those fungicide after disease were observed and those fungicide were applied three times with seven to ten days interval. Disease severity were recorded 8% on Luna sensation, 5% on bayleton and 67% on unsprayed check. Fungicide spray were started after disease severity reach 5 percent for all treatments. On fungicide treated plots the middle and upper part of the plants were not infected by powdery mildew. This implies that the development of pathogen were hampered by target fungicide. On unsprayed check the progress of the powdery mildew were very high even, the upper branch of the plant were infected and all leaf lose the green pigment and the leaf were dropped from the branch and Pods were exposed to sun light and yield were lost significantly.

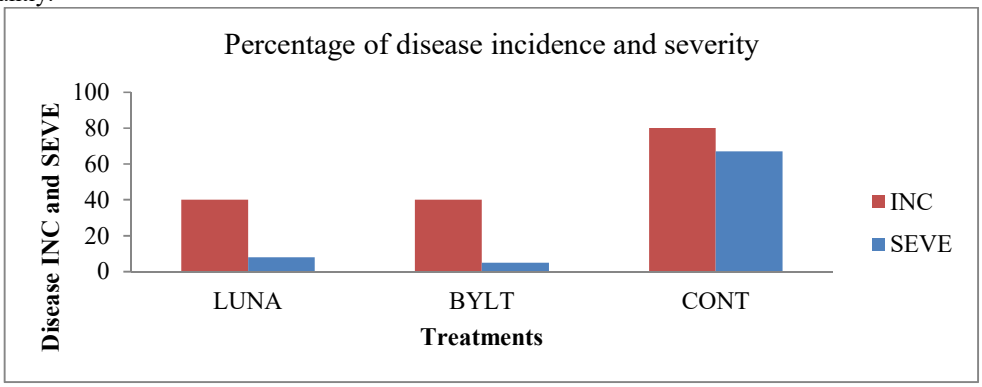

Figure 2:- Disease incidence and severity and of Luna sensation, bayleton and unsprayed check results, INC(disease incidence), SEVE(disease severity)

- Disease incidence(%)=No of diseased plants X 100 / Total number of plants examined

and disease severity was calculated by

❖ Disease severity(%)=Area of plant tissue infected X 100
Total area examined

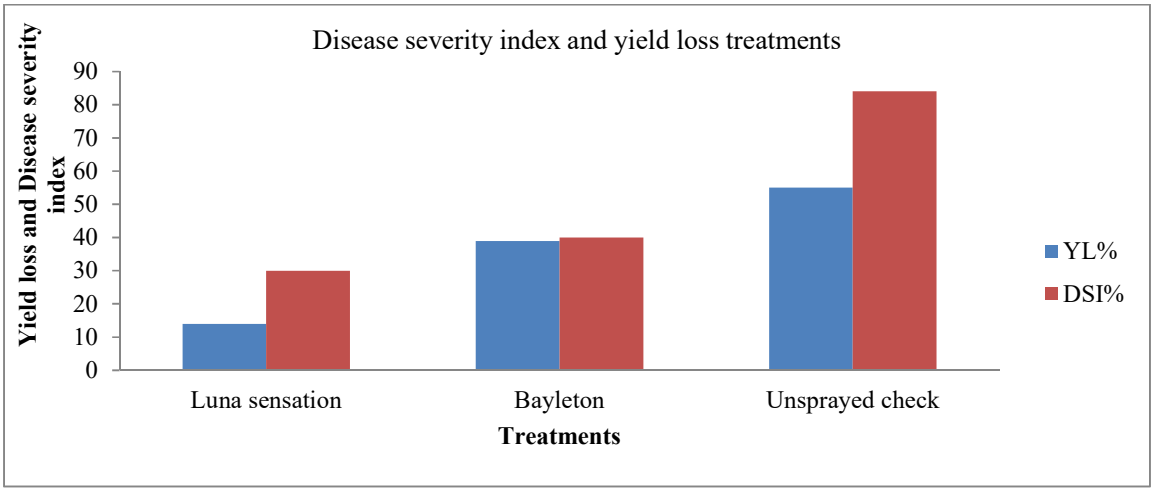

Figure 3:- Disease severity index and yield loss of Luna sensation, bayleton and unsprayed check results, YL%(yield loss), DSI%(disease severity index), Disease severity index were calculated for three treatments by using sum of all rating and maximum disease grade as shown below.

❖ Disease severity index= sum of all rating X 100
total rating X max. disease grade

and yield loss were calculated by

❖ yield loss= attainable yield-actual yield x 100
actual yield

4. Conclusion and Recommendations

In conclusion, the study confirms the use of Luna sensation and bayleton significantly reduced the effect of powdery mildew and increase the marketable yield compared with untreated check on production of pepper. The study recommends use of Luna sensation fungicide at the rate of 0.3L/ha with 150-200 liter of water per hectare prevails powdery mildew of pepper when sprayed on leaf part at appropriate time. In addition to powdery mildew this fungicide protects *alternaria spp* of pepper which is highly observed in untreated plot. This research recommends that further research should be conducted on managing *alternaria spp* of pepper in Ethiopia.

Acknowledgments

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